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ABSTRACT

Most educational computer software currently available severely restricts the kinds of interaction that can take place between the student and the computer. In fact, an examination of 317 language arts programs listed in a directory of educational software shows that 60% of the programs were of the drill and practice type. In response to this problem, a microcomputer-based writing curriculum was developed for upper elementary students. Entitled QUILL, the curriculum consists of six programs, each of which addresses a pedagogical goal in the teaching of writing. The first program, Planner, helps children to develop planning and critical thinking skills by encouraging children to take notes, write down ideas, and structure thoughts that will later develop into a piece of writing. The second goal of reading and writing integration is incorporated into the program called Library. With this program students can enter text, assign keywords, and read each other's texts. The program Publisher facilitates the third goal of making writing public by formatting written text for publication. The fourth goal, to support meaningful communication with real audiences, is handled by the electronic message systems or Mailbag. Story Maker, a story construction program, supports the fifth goal of writing with and for peers. Finally, the sixth goal of revision is facilitated by the Writer's Assistant, a text editor that helps with spelling, punctuation, and subject-verb agreement. (HOD)

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CENTER FOR THE STUDY OF READING

Reading Education Report No. 48

QUILL:
READING AND WRITING WITH A MICROCOMPUTER

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CS 007 506

Abstract

Writing and learning to write in school can be serious sources of difficulty for children. Their rich collections of ideas and stories often do not end up effectively communicated in writing. We discuss here six characteristics of writing instruction designed to alleviate this problem and describe how they have guided the development of QUILL, a microcomputer-based writing curriculum for upper elementary students. QUILL consists of a Planner for encouraging organized note taking; a Library for storing and accessing text; a Mailbag for sending messages; a text editor (Writer's Assistant) for facilitating revision; a Publisher for formatting finished text; and Story Maker, a story construction tool.

QUILL was pilot-tested in the spring of 1982 and field-tested during the 1982-1983 school year. Examples of writing activities and written products from these classrooms are included to illustrate how QUILL can affect a classroom communication environment.

QUILL: Reading and Writing with a Microcomputer

For a number of years we have been what you might call "friendly skeptics" or maybe, "skeptical friends," of the idea of computers in education. On the one hand, we have seen the tremendous value that computers can contribute in our own work. The modern electronic office has computer systems that assist in organizing information, in revising texts, and in communicating with text and graphics across great distances almost instantaneously. We often find sending electronic mail more useful than the telephone as a means of communication. We have also been involved in research on artificial intelligence--investigating what could be done if computers were really "intelligent." These experiences suggest that computers can achieve a beneficial role in education. But computers can also make bad situations worse. In the workplace, computers have often dehumanized jobs, compartmentalized work, and separated people from people. In schools, poor uses of computers can fragment education, putting barriers between subject areas, and separating teachers from students and students from students. This paper discusses these contrasts in the context of some language arts software our research group has been developing.

Uses and Limitations of Computers in Education

We will begin by discussing some problems in the current teaching of writing and then consider how computers might be used to deal with those problems. Consider one popular representation

of the problem of teaching writing in a classroom (inspired by a Bill Keane cartoon). A little boy rides the bus to school at the beginning of September with wonderful thoughts running through his head--a trip in the family car, going to the movies, swimming, and so on. When he gets to school, even more thoughts tumble around in his head. He is probably not paying a bit of attention to what is going on in class, thinking instead about a trip to the Capitol and fishing and eating ice cream cones and camping. And the teacher says, as teachers do, "Okay, you're each to write a composition on 'how I spent the summer'." And what happens? Poof! All those rich ideas disappear.

This child came to school with a wealth of ideas and experiences, but the activity that he was faced with did not build on what he knew. There is a large gap between the potential this student has for expressing and communicating and what actually happens in a classroom situation. It is crucial that education find ways to get students to talk and write about topics that are meaningful to them. How do computers deal with this issue? Are they really helping kids to develop and expand on the curiosity and excitement they have when they enter school?

To answer this question, we examined a directory of educational software published by Dresden Associates (1982). In the May 1982 issue, there were over 1600 programs for microcomputers listed, of which 317 were in the language arts area. Figure 1 (top) shows that 60% of the programs were of the drill and practice type. Some were simple games and others were

traditional frame-oriented computer instruction. Very few of the programs involved having children use language in an active way. Another way of categorizing the language arts programs is to look at the level of language they were designed to teach. Most of the programs dealt with the letter level--activities like "name the next letter of the alphabet," or the word level--"choose the correct synonym for a word." Very few of the programs--less than 10%--dealt with language at the level of sentences and whole texts (Figure 1, bottom). Looking at these categorizations together, we found there were only two programs in which kids were actively involved in using whole texts.

Insert Figure 1 about here.

When teachers have looked at currently available software, they, too, have recognized this problem. A recent study (Olds, Schwartz, & Willie, 1980) had teachers try out various kinds of software and explore how they might be used. They arrived at a number of conclusions, including the following: "Teachers saw the enormous pedagogic differences between apparent user control and real user control, between answering questions and formulating them, between recognizing someone else's ideas and creating your own" (p. 40). The teachers recognized that the ultimate success of computers in the classroom depends critically on who is in control, the computer or the child.

It is curious that while there is a growing awareness of the need to find ways to get kids to develop higher level thinking and do more writing (Elbow, 1973; Flower, 1981; Murray, 1968), software seems to be focused on the smallest units of language and on drill and practice activities. One explanation for this is that you can think of computer activities in two different ways: You can think of things that are well-suited to a computer, or you can think of things that help satisfy educational goals. Unfortunately, software creators have often ended up designing activities that are very well suited to a computer but may not really help in attaining educational goals. Conversely, there are a number of aspects of education where computers will never be of much use. Having a writing conference with a teacher or a peer (Newkirk & Atwell, 1982) is an important process that will never be replaced by a computer (although computer programs may facilitate it).

Using a Microcomputer to Develop Reading/Writing Skills

Based on this analysis, our research team has been looking at what can be done effectively with a microcomputer that also addresses pedagogical goals (Collins, Bruce, & Rubin, 1982; Steinberg, 1983). Beyond that, we have all been studying how to integrate computer activities into a classroom context. The set of microcomputer-based activities for reading and writing that resulted from our work is called QUILL. This section will discuss six of these programs, each in terms of a pedagogical goal in the teaching of writing. We will illustrate these goals

with examples from several classrooms in which QUILL and related programs were pilot-tested before QUILL was systematically introduced into six field-tested classrooms in September, 1982.

Planning

The first goal is to help children develop skills of planning and critical thinking. The centrality of planning processes in writing has recently been recognized and studied by several researchers (e.g., Flower & Hayes, 1981; Scardamalia, 1981). We have developed a program called Planner to encourage students to take notes, write down ideas, and structure the thoughts that will later develop into a piece of writing (Bruce, Collins, Rubin, & Gentner, 1982).

The left side of Figure 2 shows the kinds of questions that might be in a Planner that would lead to a book review: the name of the book, the author, what kind of book it is, who the main character is, and then some less objective kinds of questions--What is the major conflict? What was your principal feeling about the book? A student using this Planner sees these questions and answers them in any order. At the end she gets a piece of paper that has the questions she selected followed by her answers, forming essentially a structured list of notes. The right side of Figure 2 shows one student's answers. The student sees "What is the name of the book?," types in "A Wrinkle in Time" and then receives on the piece of paper afterward "Title: A Wrinkle in Time." The computer prompts, "Who is the author?,"

the student types in "Madeleine L'Engle" and it comes out as "Author: Madeleine L'Engle." The output of this Planner can be used as a guide for composing. It can also be used in subsequent class discussions or in a writing conference.

Insert Figure 2 about here.

Specific planners are created by a particular teacher and class, representing their ideas of what should be included in a given type of text. For example, students may brainstorm about what might be included in a game review--the name of the game, how to play it, and whether any special equipment is involved. Using the Planner, the teacher can take the topics that the students have suggested and create a set of questions. When she is finished, she has created a Planner that works much as the book review Planner described above: The student answers the questions he chooses, in any order, and skips the rest. After using the program, he gets a printout that he can take back to his seat to use in writing a game review. (Flower (1983) and Scardamalia (1983) have both emphasized the need to develop Planners that go beyond this genre-based type to facilitate analysis and revision of the text itself as it is generated.)

Integration of Reading and Writing

The second goal is to integrate reading and writing (Rubin & Hansen, in press; Tierney & Pearson, 1983). In pursuit of that goal, our group has designed an information exchange, a program

we call Library. We arrived at this idea while considering the fact that writers often do research--by reading--before they write; originally, we planned to provide an encyclopedia on the computer containing information that children could access. We then realized that it would be more appropriate for students to write the encyclopedia, with the computer providing the storage facility and a method for accessing different pieces of text once they have been written. We developed this idea into a system that allowed students to enter text, assign keywords, and then later read each other's texts, so that reading and writing would be integrated within the same system.

Figure 3 shows a display that a student might see on the screen when using the Library. The entries shown are restaurant reviews. Each review consists of the text itself, two authors, and the title. We have set up the system so there can be two authors, because often the kids work in pairs at the computer. In addition, keywords are attached to each entry for use in accessing what has been written. For restaurants, the authors of these reviews created the keywords in Figure 3: American, moderate, salad bar, and so on.

Insert Figure 3 about here.

Suppose you choose the keyword "moderate," meaning, "I want to see all the restaurants that are moderate in price." Figure 4

is a list of the reviews that have been written for which the author had selected the keyword "moderate." Most of them have other keywords as well. For example, Bertucci's Pizza happens to be a place where you can play bocce, and the person who wrote the review decided that "bocce" would be an interesting keyword. One of these, a review of the "Candy Connection," is by Carolyn Miller, the teacher in one of our pilot classrooms. In addition to "moderate," she used the keywords "candy" and "sweet" to further define the topic of her review. Her review reads:

> There's a variety of scrumptious candy with a wide selection of yummy chocolates. Fruit dipped in chocolate or chocolate covered nuts and raisins are some of their specialties. Jelly beans in every flavor are available. All candy can be packaged in many unusual containers. Dentists, eat your hearts out.
>
> Keywords: /moderate/candy/sweet

Insert Figure 4 about here.

In May and June 1982, our research team tried out the Library for the first time in a classroom by having kids write game reviews. Our pilot test was in a fourth-grade classroom in Brookline, Massachusetts. First the teacher conducted a brainstorming session to generate the important points in a game review. The students came up with: what did you try to do, did you like it, how many chances do you get in each turn, what are

the rules, how hard is it, what are the secrets for winning, is it fun, where should you buy it, where can you play it, what happens when you reach a certain score, what's the name of the game, etc. (At the time, Planner was not yet finished, but normally using a Planner would be the next step in the process.) Students composed their reviews (working in pairs) and typed them into the Library. After the first few reviews were typed in, each group that came up to type in their review ended up reading all of the others as well. They wanted to read what others had written, and the computer made that easy to do. Here are two examples of their reviews. The first one is called "Jumping Rope."

> Jumping rope is not as easy as it looks. You must be well-coordinated and patient. This is how you do it. Step 1: Hold the rope in both hands, one on each end of the rope. Step 2: Bring the rope over your head. Quickly jump over the rope and start again. When you're first learning how to jump rope, it's best to start with a little help. You play outside. Be careful you don''t get tangled up in it. For a good one it is about $1.99. It is great fun and good exercise.
>
> Keywords: /arcade/far-out/home/

(The authors of this review later complained that they couldn't delete "arcade," which they had mistakenly included as a keyword.)

The second review is on "Asteroids" (about half of the reviews were about electronic games).

If you like fast-moving space action, then you should try Asteroids by Atari Company. Your ship is a triangle which shoots lasers. You maneuver the ship across the board with a joystick. As you are bombarded by meteorites you try to blast them into space dust. If you succeed, you pile up points. To make the game even more [there should be an "exciting" in here, we were told by the authors], there are randomly shooting UFOs. Asteroids is available for your Atari home computer system. It is also available in most arcades. Asteroids is a very good video game.

Keywords: /electronic/video/space/arcade/home/

For each of these reviews, one of the two authors was a student who spent time in the special needs resource room. In using QUILL, both of these students got involved in writing with someone else in a way that made them feel successful. They "published" their writing, both by storing it on the computer and by printing out multiple copies on the printer. We watched one of these two pairs typing in their review. The more advanced student typed in the first half of the review, and then there was a moment when he looked at the teacher and said, "Can I go now?" She said, "No, you have to help V type in the other half." V had a lot of trouble, but B stayed and helped him type, showing him which letters to type when he got stuck. B learned more by

serving as a tutor, and they both shared a sense of pride in creating a publicly available text.

This classroom also offered suggestions for the further development of QUILL. One of us had put up a sign next to the computer saying, "Tell us what you think we should change." The kids were not bashful. Two of their suggestions were quite interesting. The first was, "If your program is on a disc and you find a mistake, you can (sic) fix it." Unfortunately, because we were in the midst of developing the system, we had not been able to provide them with a full text editor. We were surprised, though, by their insistence on being able to change what they had written. They really were committed to the idea of revision and were not satisfied with their first drafts.

The second suggestion had to do with the printed copy a student can get after writing an entry. We had made the mistake of having the system print out only one copy, but all the reviews had two authors. The students reminded us that each person who contributed to a review should have a copy.

There are myriad classroom activities that might make use of this general information exchange. One disk might contain texts that describe how to accomplish certain tasks: How to build a bird house, how to make ice cream, or how to make chocolate chip cookies, all indexed by relevant categories. A class could create a computerized encyclopedia with expository entries about various topics--animals or ecology or anything that is already being worked on in the curriculum. Finally, because each of

these entries has an author attached to it, it is easy for a teacher or a student to look at a portfolio of all of a student's writing at a certain point in the year.

Publishing

Our third goal was to make writing public. Writing needs to be read by peers, by people who know what its purpose is and are expected to be affected by it. Too often students write for their teacher, but for no one else. Making writing public implies "adult" notions of publishing, of presenting texts in formats that are meant to be read by others (see Graves, 1982; Graves & Hansen, 1983).

One of the standard formats that classroom teachers use is a newspaper. Unfortunately, class newspapers are not easy to produce. The first newspaper of the year always sounds like a great idea. Everyone talks about it and thinks it is wonderful, the students write articles, the teacher stays up late at night typing, finally does all the pasting up and formatting, and finishes a first issue to everyone's acclaim. Unfortunately, the process is so laborious that the next issue of the newspaper never appears. In a third-fourth grade class at the Garrison School in Oceanside, California, students regularly produce the Garrison Gazette using their Apple computer (Levin, Boruta, & Vasconcellos, 1982). Students in the class write their articles on the computer. When they are finished, the computer prints out the articles in the correct column width and prints the date and

volume number at the top. After the articles have been written, it is a fairly small step to produce the newspaper.

The authorship of several articles in the Garrison Gazette is interesting. One "News" article says, "On March 30, Speedy died from a germ. Snoopy started to eat Speedy. A was Snoopy and Speedy's owner. We buried Speedy at 11:00 a.m. Now Snoopy is the only rat in C-2." This was written originally by A, who also put his name on it, but it was edited later by B and L. Thus, it is the product of at least three people's work, and that process is recorded as part of the newspaper.

Another article was written by M and J. "Today is April 2nd, 1981. It was raining this morning. The temperature is 71 degrees Fahrenheit. The sun is coming out now and it is getting warmer. The clouds are big, fat and white." The same kind of collaboration that happened when students used the Library occurred when they wrote this newspaper.

Publisher, the general utility program our group is planning, will publish not only class newspapers but books (with an automatic table of contents so the page numbers are correct for different chapters of the book). Individual students might write different chapters and put them all together into a class book. The program also helps in formatting memos and personal letters. Any kind of writing with conventional formats can be facilitated by a Publisher.

Addressing Real Audiences

The fourth goal that we have is to support meaningful communication with real audiences. The underlying idea here is that reading and writing have purposes and that being aware of your audience and the effect you want to have is an important aspect of writing (Bruce, 1981). The relevance of audience and purpose is most obvious in conversation, where the norm is to know whom you are talking to and to expect a response.

In order to create that kind of environment for writing, we have come up with an electronic message system. The students' response to this message system--the Mailbag--has been extraordinarily enthusiastic (Steinberg, 1983). The messages they wrote are not polished compositions, but they are obviously examples of children writing about things they care about. Here's one message from M to B:

> B., do you think I should get Space Invaders or Quest for the Rings? Can you come over today? I hope you can. Here's a riddle for you. If an athlete gets athlete's foot, what does an astronaut get? I'll give you the answer when you type me a message, but you also have to take a guess. Bye bye, B. Oh, by the way, you won't get the answer from any of my joke books.

Not much later the following message came back:

> Dear M.: I think you should get Quest for the Rings because Space Invaders on Odyssey stinks. Sorry, but I cannot come to your house today. I have to work on my autobiography,

get new shoes, and go to a party. Sorry. As for your riddle: Meteor's Foot? Sorry, I can't come over."

(The answer to the riddle, by the way, is "mistletoe.")

These kids sit about three seats apart, but the idea of typing messages to each other on the computer was exciting enough to them that they exchanged several messages over the course of a few days.

In this class, the students were writing their autobiographies (using pencil and paper) while they were using Mailbag on the computer, and they soon started commenting on each other's autobiographies in their messages. One student would write an autobiography that was read by another student in the class who would then write a message about it that was read by the first student. Here is one example: "Michael, your autobiography was great. I think the pictures are really great too. You should be an artist when you grow up. You'd be very successful. I like the pictures you made in my autobiography too. You're a very, very good artist."

In addition to this relatively free message activity, our group has formulated more structured activities using the Mailbag. The Mailbag allows a student to send a message to all the members of a club at once, just by specifying the club name as an addressee. This facility could encourage the formation of classroom clubs such as dinosaur, video game, and sports clubs. In addition, Mailbag has a Bulletin Board on which a message to

the whole class can be posted. A teacher can put something on the electronic bulletin board like "Today we're going to work on the Civil War." One of the students in our pilot clasroom took advantage of the Bulletin Board option. He wrote the following message: "To Classmates. I don't want to go but I have no choice. I'm going. Going where, you ask? To another school. It is called Solomon Schechter. But do not fear. I am still here, but not for long. I will be gone. Your friend, A." Everyone who logged onto the system got his or her own copy of the message, keeping A from having to write it out many times.

The computer also allows writers to remain anonymous. Some of the messages had signatures like "Guess who?" This facility allows a kind of conversation about personal problems, in which the person who poses the problem and those who respond are all anonymous.

All of the above examples come from a message system within a single classroom. To communicate between classes at the moment teachers have to carry a disc physically or mail it to another class. But we are also working on developing a system that would send messages over longer distances. The scenario for its use is this: Students write the messages they want to send to another school. At the end of the day the teacher leaves the computer plugged in on a local phone line. A program waits until 2:00 a.m., dials the phone number of a large computer, sends its messages to that machine, and "goes back to sleep" until 4:00 a.m. At 4:00 a.m. it wakes up, and calls back to pick up any

messages that have been left on the large computer for it. In the morning, the teacher comes in and sees on the screen "Last night you received two messages from Cambridge and three messages from Alaska."

Being able to communicate with distant classrooms introduces new possibilities. Imagine, for example, that in Massachusetts a class is compiling an animal encyclopedia by writing articles about local animals. They could send a message to Alaska or Hawaii and say, "We're doing an animal encyclopedia. Do you have any animals that we might not have that you could write about? Could you send a message that we can include in the encyclopedia we're creating?" Soon, their encyclopedia might contain an article on polar bears or tropical birds.

Writing with Peers

A fifth goal is to encourage writing with and for peers. In this context, we will describe Story Maker, a program that our BBN team has been working on for the past several years as a reading and writing activity (Rubin, 1980, 1982; Zacchei, 1982). Using Story Maker, students construct stories by choosing already-written story parts to put together.

One of the insights that guided Story Maker's development was that when students write, they often downslide (Bruce, Collins, Rubin, & Gentner, 1982; Collins & Gentner, 1980); they focus on the lowest level of writing--on handwriting, punctuation, and word choice, and spend too little time on idea

development and higher-level organization. We wanted to reverse the situation and invent an activity where it was impossible for students to focus on punctuation and word choice, because they were already taken care of. Students could then devote all their attention to the connections between ideas in their story.

Here is an example of what happens when a student uses Story Maker. She starts out with the beginning of a story--"Lace opened the front door and . . ." and then she's given several choices of the way that story might proceed. In this case, the options are either

". . . saw the joker,"

". . . slipped into what looked like a big bowl of spaghetti,"

or

". . . stepped on a mouse."

Let us follow the second option. "Lace opened the front door and slipped into what looked like a big bowl of spaghetti." Given this beginning, there are two possibilities for the next story part: Either "Frankenstein was cooking it for his dinner," or "It was really the mummy taking a bath." (The mummy taking a bath looked like spaghetti because he was all unwrapped and the wrappings filled the bathtub.) When a student makes a choice, the next choices she sees are determined by her previous choice (unlike Mad Libs, in which the individual choices are independent). The choices are structured as a tree, as in Figure 5. The student goes on making choices until she ends up with a story at the end.

Insert Figure 5 about here.

Again, the most interesting insights into language use come from watching children use the program. One ten-year-old boy using Story Maker chose a set of stories for his seven-year-old sister. He went through all twenty-five stories in the Haunted House tree, chose seven that he thought were appropriate, and made them into a book for her. Some of the others he probably thought were too short, too uninteresting, or too scary for his sister. Here is one of the stories that made it into the book:

> Lace opened the front door and slipped into what looked like a big bowl of spaghetti. Frankenstein was cooking it for his dinner. Before Frankenstein got too angry, Lace suggested that they go to McDonalds. When Lace and Frankenstein walked up to the counter, Frankenstein ordered twenty-five Quarter Pounders with Cheese, six gallons of Coke, and four large fries. The waitress was too scared to ask him for the money. After they carried all the food back to the haunted house, Frank ate every bit of it and then he ate Lace for dessert.

He titled this story "Never Go To McDonalds," illustrated it, paginated it, and bound it with the other six stories. It was interesting that he had chosen as his own task in using Story Maker to compile seven stories for his sister. It was something he could never have done in an hour if he had sat down with seven

pieces of blank paper. In making decisions about how to construct those stories, though, he was paralleling the choices authors make for particular audiences.

In order to encourage children to think about the stories as they construct them, we have added goals to some of the Story Maker trees. The computer will present a student with a goal at the beginning, and evaluate the story at the end with respect to that goal. Some of the goals for the Haunted House story tree are to write a story in which: Lace marries the mummy, Lace dies of ratbites, Michelle helps Lace escape from the vampire, etc. The computer gives a student one of these goals selected randomly, lets him make a series of choices, and then at the end says, "Congratulations, Chip, you've come up with the story that I expected you to come up with." Or, "I'm sorry, Andee, but you didn't quite come up with the story I expected. For choice number 3, you chose 'Lace walked out of the house,' and you should have chosen 'Lace walked into the rat den.'"

A third way to use Story Maker allows students to do their own writing. After reading some of the sets of choices, students often want to add something of their own. So, a program called Story Maker Maker has been added, in which students get to add their own pieces to the story. Given the beginning, "Lace opened the front door and," a student could add, "bumped into E.T.," and then decide whether the new path he or she had initiated should continue on its own or feed back into the existing tree (see dashed line in Figure 5).

Using Story Maker Maker, a whole class could get together and construct a story tree one part at a time. The teacher could start it and add the first few choices. Then over a period of weeks, students would add their parts, ending up finally with an entire tree which they could even exchange with another classroom. The important point here is that the story part each student has written is automatically read by other students. What students write with Story Maker Maker is not only read by other students, but other students actually interact with it. Using Story Maker is, in a sense, a way of writing collaboratively, because the students who are making the choices among story parts are part of the writing process, as is the person (or people) who made up the original tree. In fact, the Haunted House story tree discussed here was written by a fourth grader with the help of one member of our group (Cindy Steinberg).

Revision

Our final goal is to facilitate revision, and particularly to encourage students to do more kinds of revision--not just to fix the spelling error that the teacher marked on the paper, but to consider putting two texts together to create a longer one, or switching the introduction and conclusion, or other major changes in the text. Even young children can learn to carry out such revision (Graves, 1982). The text editor included in QUILL (Writer's Assistant, developed by Jim Levin) facilitates such

higher-level revisions (Levin, Boruta, & Vasconcellos, 1982; Levin, 1982).

Figure 6 is a first draft of a paragraph from a proposal. There are several mechanical and stylistic problems with this text. Using a text editor, all of the changes shown are easy to make. A writer can substitute one word for another ("cannot" for "can't," "wane" for "lessen") or change multiple occurrences of the same word. What is even harder to do on a typewriter, and more important in the context of learning about revision, is to move a whole sentence around, to get rid of a whole sentence, or to try out a different order of sentences, decide you do not like it, and return the sentences to their original order. With a text editor, it is easy to take the entire sentence, "They can succeed educationally only in the context of other rich and motivating activities," move it down, take out "They are expensive too," and connect the moved sentence with the one following it so that it now reads: "They can succeed educationally only in the context of other rich and motivating activities, but they provide an important source of leverage for teaching writing."

Insert Figure 6 about here.

The structural changes indicated in Figure 6 definitely improve the paragraph, but with a typewriter or paper and pencil, the writer would be forced to recopy the whole piece. On a word

processor, moving those sentences takes just about as many keystrokes as substituting "cannot" for "can't." The power of a text editor, especially for kids for whom the thought of editing often has to do with erasing something until there is a hole in the paper, is that now revision is made easy.

Computers can also help with spelling, punctuation, and subject-verb agreement. Writer's Assistant, for example, includes a command (called "Mix") that displays all the sentences in a student's text starting at the left margin. A student can quickly scan the list of sentences and see if all of the first letters of sentences are capitalized, if end punctuation is missing, if there is a run-on sentence, if the sentence length is varied, and if there are any sentence fragments. The computer does not actually identify any of these; it just makes it a bit easier for students to see problems and fix them. The sentences can then instantly be reorganized in paragraph format.

QUILL, then, contains the following components: a set of planning aids (Planner); an information exchange (Library); publication aids (Publisher); a message system (Mailbag), and an activity kit, including Story Maker and Story Maker Maker. A text editor (Writer's Assistant) is also included in QUILL.

Training Teachers and Students to Use the System

Teaching teachers how to introduce students to QUILL is as important as the software itself. QUILL includes a series of lesson plans which guides teachers through the first several

weeks in the classroom. As shown in Figure 7, there are computer activities, non-computer activities students do as individuals or in pairs, and lessons that the teacher teaches. The teacher starts by teaching a lesson about computers, then goes on to a lesson on the Library system itself--how it is organized and what keywords are--and a third lesson brainstorming about the content of reviews. Fourth, students actually go to the computer, use the Library program, and read some reviews that have already been entered either by us or by the teacher. The teacher creates a Planner from the brainstorming list so that after students have, in pairs, chosen the game they are going to review, they can use it. Students generate, using the Planner, a structured set of notes which they then use in conferences either with one another or with the teacher. As a result of those conferences they compose a draft on paper. (Eventually, when there are enough computers, students will compose on the computer, but for now the computers are in limited supply, and a classroom runs more smoothly if some composing is done first on paper.) Finally, students use the editor (Writer's Assistant) to enter their drafts and put them in the Library.

Insert Figure 7 about here.

Students conference again with teacher or peers about what they have typed into the Library. The teacher then teaches them more sophisticated revision techniques using the Editor, and

gives them a chance to use the Editor to revise their reviews. Finally, the whole class discusses which keywords would be useful for their set of reviews, individual students choose their own keywords, and then go to the computer to add those key words and to read other reviews. In these few weeks students are being introduced to three things: computer literacy, the QUILL system, and a process approach to writing, including planning, conferencing, and revision.

Research on Computers and Writing

The recent growth of computers in education has naturally led to research questions about the effects software can have on classrooms, students, and teachers. One of the first results that investigations of computers' roles have produced is the recognition that the computer alone does not account for the most important changes which take place. Rather, modifications in the social organization of the classroom, changing roles of teachers and students, and changing attitudes toward learning are all central mediating factors of computers' effects.

Unfortunately, most computer software currently available for educational use severely restricts the kinds of interaction that take place between the student and the computer. The implicit model is that of a student working alone on a constrained, pre-designated task. Evaluation of responses is done solely by the computer, with little opportunity for either the student or the teacher to alter the mode of interaction or

adapt it to current classroom needs. These programs may be useful in teaching specific skills, but taken by themselves, they exemplify a limited vision of the ways computers can be used in education.

There are related limitations to much of the research on computers in the classroom. First, most evaluation studies have focused on traditional frame-based computer-aided instruction (Chambers & Sprecher, 1980; Edwards, Norton, Taylor, Van Dusseldorp & Weiss, 1974; Moshowitz, 1981), a technology that now appears to be useful primarily for certain tightly-defined instructional tasks. Second, studies of specific innovations have typically emphasized the software or hardware (Daiute, 1981; Malone, 1981)--with the general aim of promoting and/or improving it. While such studies are essential, they need to be followed by investigations of technology's actual impact on the people involved. Third, most studies have been done in a laboratory or model school setting, with enthusiastic, knowledgeable teachers, if not the researchers themselves, introducing the computer to the class. Such a setting is vastly different from the typical classroom with its limited resources and possible indifference or even antagonism from the teacher. Fourth, most studies are product-oriented; they measure learning by means of a standard pretest/posttest design or look at computer-collected data on students' use of the computer. This research, by its very design, cannot perceive changes in the learning process,

classroom structure, students' sense of purpose in learning, or teacher/student roles that may be altered by the computer.

The eventual impact of computers on education will be substantial; in fact, computers have already begun to change the teaching of science (Abelson & diSessa, 1981), math (Bork, 1981; Dugdale & Kibbee, 1975; Papert, 1980), reading (Zacchei, 1982), and writing (Levin, Boruta, & Vasconcellos, 1982; Collins, in press). The greatest changes will come from programs which not only allow, but require, active involvement and collaboration of students and teachers for their success (e.g., LOGO, QUILL, Interactive Text Interpreter). These more open-ended programs establish new environments for learning or provide tools for carrying out functional tasks. The changes they can bring about are dramatic; at the same time, their use requires substantial support from peers and adults, and much more needs to be learned about their effects on classroom practice.

Unfortunately, the research to date provides only a glimpse of these changes. QUILL, for example, was field tested in school districts in Connecticut, Massachusetts, and New Jersey during the 1982-1983 school year. The system will be evaluated by comparing pre- and posttest writing samples from experimental and control classrooms. We have also conducted a comparative study of the pattern of use and effectiveness of QUILL's message system in the field test classrooms. Students' messages were analyzed according to the use of purpose, audience, and reciprocity. The rate of message writing was also recorded for each classroom.

Several independent variables such as prior computer experience of students, classroom organization, and teachers' computer knowledge were examined as potential predictors of classroom success with Mailbag. Findings of this study are reported in Steinberg (1983). Also, limited classroom observation has produced interesting results and hypotheses for future study.

In particular, a major need is for systematic, long-term, ethnographic studies of classroom events and interactions. This must be undertaken if we are to understand such things as how teachers attempt to integrate microcomputers and computer activities into the classroom; the shift of roles for both teachers and students when computers become part of the everyday life of classrooms; and the impact of computer use on students' understanding of themselves and their work.

The most important impact of microcomputers on writing may be changes in the larger classroom writing "system" rather than changes in the technology of writing (e.g., speed, printed output, ease of revision). For example, in "milling around" the computer waiting for their turn to use it, students may read each other's writing and talk about it. These interactions may affect both the content and form of student writing. Similarly, peer interactions during writing on the computer, student access to other students' work stored in the computer, and programs like Mailbag in which students send messages to each other, can affect students' understanding of purpose in writing, and their sense of

audience. What is needed is research that looks seriously at the changes brought about in the classrooms, the teachers, and the writing process.

Conclusion

All of this writing about writing brings the following to mind. One of us was trying to write a journal article and had really gotten stuck, so as he usually does when in that situation, tried to procrastinate by reading. He came across the following poem (Roy, 1982) and was struck by its appropriateness.

Author, Author
Susan Davis Roy

By a romance with words
Life-long I've been smitten
I don't want to write
I want to have written.

Computers will never make writing or understanding texts an easy process. But if we try to design and demand computer activities that show a real respect for the learner and for language, it is possible that children will become more actively involved in developing their own reading and writing skills, so they too, will understand the joy of writing and "having written."

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Figure Captions

Figure 1. Types of currently available language arts software.

Figure 2. A Planner for book reviews.

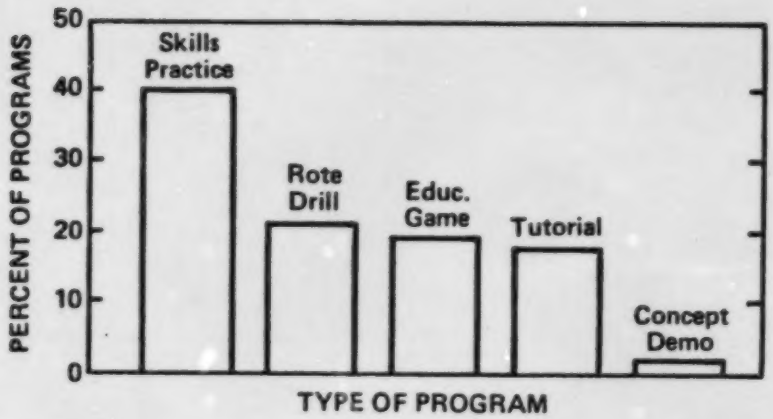
Figure 3. A display from the Library: Keyword choices.

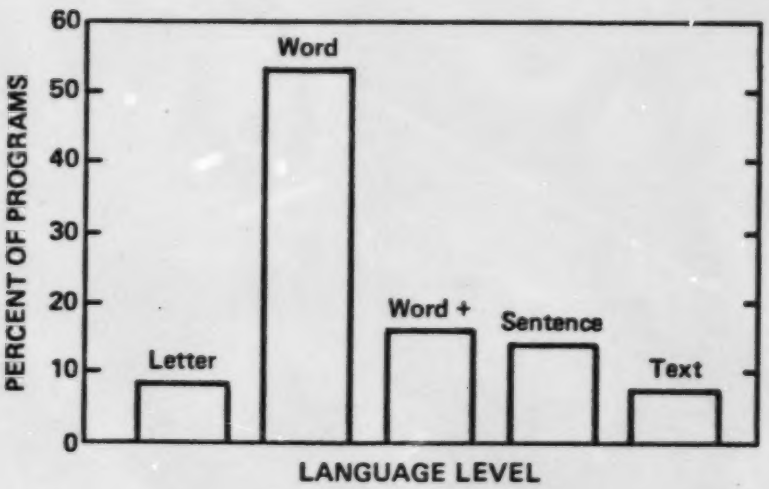
Figure 4. A display from the Library: Entry choices.

Figure 5. A Story Maker tree.

Figure 6. A text under revision.

Figure 7. Introducing the class to QUILL.





CONTENT AREA	NO. OF PROGRAMS
Language Arts	317
Social Studies	226
Math and Science	812

Compiled From "School Microware Directory," Dresden Assoc., Spring 1982.

BOOK REVIEW

- What is the name of the book?
- Who is the author?
- What type of book is it?
  1. Mystery
  2. Science Fiction
  3. Humorous
  4. Non - fiction
- Who is (are) the main character(s)?
- What is the major conflict?
- What was your principal feeling about the book?
- What is the main idea of the review?

(1) Title: A Wrinkle in Time

(2) Author: Madeleine L'Engle

(6) Main Feeling: mystical

(5) Major conflict: a struggle against evil in the fourth dimension

There is information available for these keywords. Type the NUMBER of the keyword you want. You will be able to use more than one keyword but you can enter only one at a time.

1 AMERICAN	8 STEAK
2 MODERATE	9 HUNGARIAN
3 SALAD-BAR	10 MUSIC
4 CROCODILES	11 CANDY
5 SUMMER	12 BOCCE
6 CHEAP	13 WORMS
7 SANDWICHES	14 NONE OF THE ABOVE

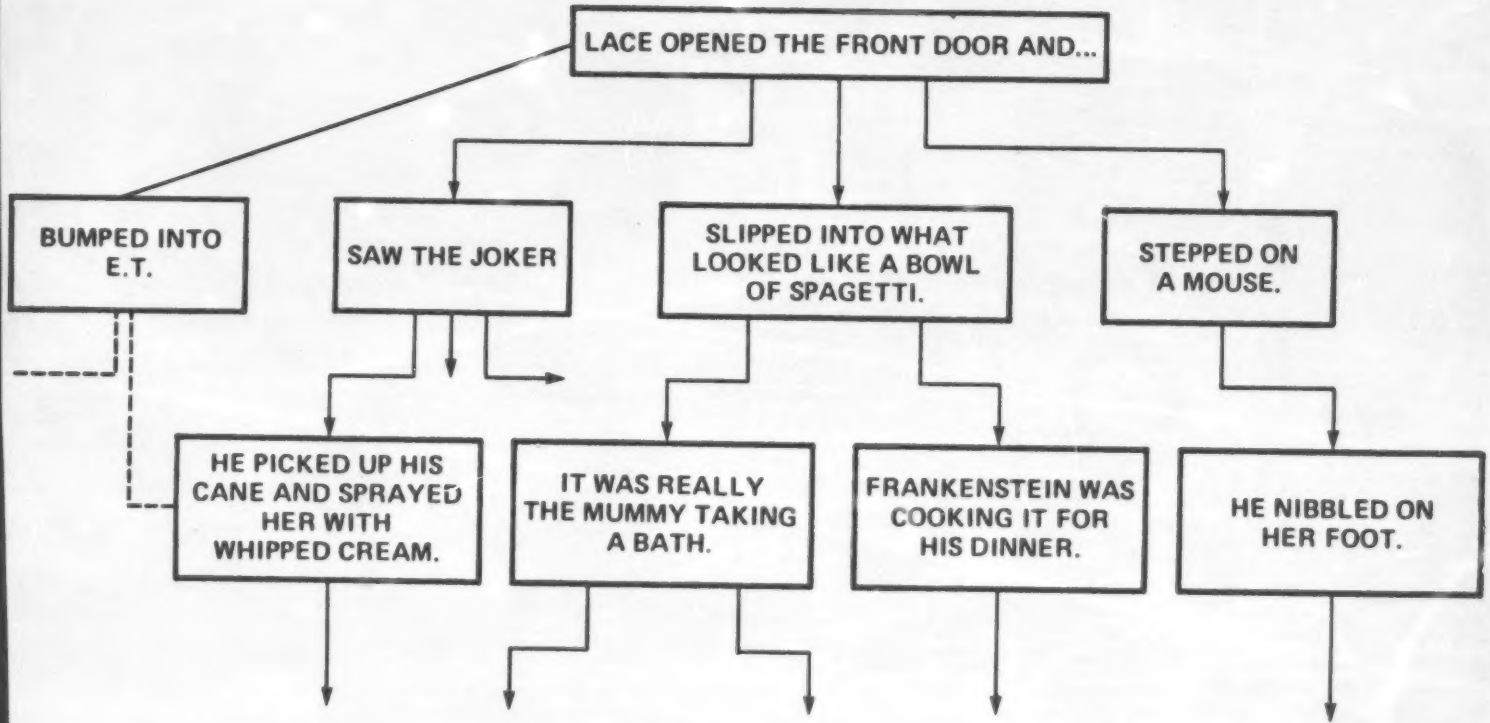
Type a NUMBER and press RETURN.

There are 4 entries with the key
MODERATE.
Type the NUMBER of the entry you would like to see.

TITLE	KEYWORDS
1 33 DUNSTER ST.	AMERICAN, MODERATE, SALAD-BAR
2 CLUB CASABLANCA	MODERATE, CROCODILES, SUMMER
3 NEWBURY STEAK HOUSE	AMERICAN, MODERATE, STEAK
4 BERTUCCI'S PIZZA	MODERATE, BOCCE
5 NONE OF THE ABOVE	

Type a NUMBER and press RETURN.

THE HAUNTED HOUSE


LACE OPENED THE FRONT DOOR AND...
BUMPED INTO E.T.
SAW THE JOKER
SLIPPED INTO WHAT LOOKED LIKE A BOWL OF SPAGETTI.
STEPPED ON A MOUSE.
HE PICKED UP HIS CANE AND SPRAYED HER WITH WHIPPED CREAM.
IT WAS REALLY THE MUMMY TAKING A BATH.
FRANKENSTEIN WAS COOKING IT FOR HIS DINNER.
HE NIBBLED ON HER FOOT.

Of course, computers are not the answer to all of education's problems. They can succeed only educationally in the context of other rich and motivating activities. They ~~can't~~ cannot substitute for human interaction; they have limited comprehension skills; their motivational potential may ~~lessen~~ wane as they become more commonplace. ~~They are expensive, too.~~ ~~Nevertheless,~~ but they provide an important source of leverage for teaching writing. ~~skills.~~

QUILL in the Classroom

Lesson	Writing Time	Computer Time
1. Computer		
2. LIBRARY		
3. Reviews		
		4. See LIBRARY
	5. Pick topic	
6. PLANNER		
		7. Use PLANNER
	8. Conferences; compose draft	
9. Entering & local editing		
		10. Use EDITOR to enter draft into LIBRARY
	11. Conferences; plan revisions	
12. EDITOR		
		13. Use EDITOR to revise review
14. Keywords		
	15. Choose keywords	
		16. Add keywords
		17. See other reviews